Collaborative Platforms for Sustainable E-Learning in Higher Education

Subjects: Information Science & Library Science | Education & Educational Research | Behavioral Sciences
Contributor: Simona Sternad Zabukovšek, Zdenko Deželak, Silvia Parusheva, Samo Bobek

E-learning platforms have become more and more complex. Their functionality included in learning management systems is extended with collaborative platforms, which allow better communication, group collaboration, and face-to-face lectures. Universities are facing the challenge of advanced use of these platforms to fulfil sustainable learning goals. Better usability and attractiveness became essential in successful e-learning platforms, especially due to the more intensive interactivity expected from students.

Keywords: e-learning platform ; collaboration platform ; usability ; user experience

1. E-Learning Collaboration Platforms

The usual practice of universities involves using the Learning Management System (LMS), which has its older traditions back in time. Researchers point out that in an open society, with increasing distribution as well as access to information dynamics, it is difficult to use it traditionally [1][2]. This determines the paramount role that e-learning platforms play in higher education. Through them, students gain access to the digital educational content of the courses, tests for self-preparation and assessment, etc. Researchers point out that using e-learning platforms as a tool for self-study contributes to a substantial difference in the use of resources and results in increased learning efficiency [3]. LMS significantly change the teaching experience of both teachers and students and is used very intensively [4]. COVID-19 pandemic affected the closure of all educational institutions, including universities, along with the shift to complete online learning and affected a series of changes in learning and teaching process which required technology [5]. Implementing effective learning in a remote, electronic-based environment has become a key issue in education [6][7][8][9]. As a solution, e-learning platforms, LMS platforms, video conferencing systems, and online collaboration tools (for example, Microsoft Teams, Zoom, Google Meet, Webex, etc.) have intensified.

E-learning platforms are web-based platforms for providing digital educational content and managing the learning process. As mentioned earlier, universities integrate into their e-learning platforms a range of different systems and tools. Among them are world-renowned LMS platforms such as Blackboard, Canvas, Moodle, Google Classroom, and more. Of these systems, Moodle and Canvas are free platforms. In addition, it should be noted that Moodle is an open-source system, while Blackboard is a paid system. Statistics on the use of e-learning platforms show that in more than 1600 institutions surveyed in Europe, 65% of them use Moodle, 12% Blackboard, followed by other platforms (ILIAS, APG Learning /Sakal/, etc.) with a share between 4% and 1% [10]. These figures prove the leading positions of Moodle among the used e-learning platforms. In addition to LMS platforms, a new generation of e-learning platforms emerged, oriented not only in content sharing, but also in facilitating e-learning collaboration. In most cases, universities' use of Google Meet, Zoom, and Microsoft Teams as collaboration tools has intensified.

Somova and Gachkova point out that Moodle is one of the world's most widely used platforms in over 200 countries, with more than 170,000 installations, where 250 million users use more than 30 million courses [11]. In addition, Moodle is coded in the PHP programming language and is issued under the General Public License (GNU). The platform is developed in compliance with the pedagogical principles and is used for blended learning, distance learning, flipped classrooms, and other areas of e-learning in schools, and universities, to maintain corporate qualifications and more. Some authors emphasise the important features that determine its widespread use. Moodle is argued to be the optimal Virtual Learning Environment (VLE) platform in terms of the tools at its disposal and its technical aspects [12].

Other authors [13] cite the leading features of Moodle, the excellent organisation of online sources, their accessibility and convenience, good structuring, and the effectiveness of communication tools. Evgenievich et al. [14] summarise the opinion of researchers and practitioners about the benefits of Moodle LMS in several directions: (1) many opportunities to increase the individuality and responsibility of students; (2) the possibility of using a variety of platform resources that enrich and at the same time develop skills for working with material; (3) the opportunity to progress individual educational paths; and (4) create an environment for acquiring new knowledge, experience exchange, and consulting. Some authors also emphasise the possibility of synchronous and asynchronous access and group work [15].

On the other hand, the authors highlight that communication in Moodle is not so widespread, with a greater interest in the use of social media and specifically social networks, as well as mobile applications [9][16]. For this reason, instant

communication applications, such as Messenger, WhatsApp, Viber, and others, are especially popular and used. The Moodle forum module can be used for asynchronous group communication and collaboration, while for synchronous communication, Google's Google Meet tools are preferred, as well as Microsoft Teams, Zoom, Webex, etc.

Google Meet is defined by the authors [17] as a "synchronous learning tool for distant online programs". Google Meet and Microsoft Teams Rooms and their videoconferencing features provide a good basis for active interaction between lecturers and learners. Through them, effective synchronous work with students and their fuller engagement in the learning process is achieved. Research by many authors indicates the main possibilities used through these applications. Links to web-based classrooms are created by educators and are integrated into learning courses in Moodle. This combines the use of these tools, with Moodle LMS offering much more comprehensive and complete support to students and faculty through a variety of activities and resources, but primarily asynchronous, and Google Meet and Microsoft Teams offering synchronous communication for lectures and seminars. Due to video conferencing functionality, live lectures or seminar sessions are held with students [18].

Gartner recognised the Microsoft Teams application as a leader for unified communications as a service (UCaaS) and meeting solutions [19]. Microsoft Teams was placed highest of all solution providers for its ability to execute. Microsoft Teams is an application that supports internal and external team members in connecting and collaborating synchronously [20]. People can have one-on-one or many-to-many meetings or calls with fully integrated voice and video, informal chats, co-authoring a text, or participate in other applications and services. Microsoft Teams offers a shared workspace for people where they can quickly restore or repeat the project and allows you to work with team files and participate in shared results. Every new team created a new group, an online site using SharePoint complete with a document library, a OneNote notebook, Exchange online (shared calendar and mailbox), and is highly integrated with other Microsoft 365 and Office 365 applications (e.g., Power BI, Planner, Forms etc.) [20]. Microsoft is rapidly developing new capabilities into Microsoft Teams application—there is an update every month, and the dozens add new features. They also support the UserVoice initiative, with which everyone is able to suggest new features, and users vote on them—the most requested features get to be added in the coming updates. More recent added features incorporate [20]:

- "Together mode", which offers a simulation of actual meeting members being in the same room;
- Customisable meetings that support setting up breakout rooms for meeting in smaller groups;
- Ability to record the meetings on the go, accompanied with meeting notes and transcripts.

One of the latest investments by Microsoft is Microsoft Teams Rooms, which provides a mutual experience as in a standard office meeting room. This way, users can experience hybrid work scenarios that support simplified meeting starts and effortless sharing of content with complete audio and video collaboration [20].

Florjancic and Wiechetek [21] compare LMS platforms Moodle and Microsoft Teams and state that Moodle is a complex tool, but at the same time, it is a complicated platform. On the other hand, they define Microsoft Teams as a relatively new and simple tool with a modern design and easy to use. Particular emphasis is placed on its simplicity, real-time communication, and opportunities for integration with Microsoft Office 365.

It can be summarised that Moodle LMS, Microsoft Teams and Google Meet as e-learning tools support educators and students in different but complementary aspects. Moodle has significantly richer capabilities thanks to the many activities and resources built into the platform, but mainly for asynchronous support and collaboration. On the other hand, the potential of both Microsoft Teams and Google Meet tools for synchronous online communication and online lectures and seminars sessions is irreplaceable, especially in the difficult times of COVID's restrictions and the closure of universities.

2. Attractiveness of E-Learning Collaboration Platforms for Students

Many researchers have researched e-learning as an approach to providing educational content within study programs, and many publications have been published. Many published research studies have been focused on technology issues of online teaching and online learning. Studies emphasise technological issues related to using online platforms and creating online content such as audio-visual and interactive content in higher education. Some studies are related to the hosting of knowledge bases and accessing such knowledge bases. Other studies are focused on online communication between the teacher and students and among the students within study programs.

However, teaching and learning are not all about the technology used in such a virtual environment. It also has its social and psychological dimensions. For sustainable learning, the teacher's and student's needs, desires, motivations, and interests, as well as perspectives, are also studied and taken into account. Only such a holistic approach can lead to sustainable higher education, improving the efficiency and effectiveness of online learning.

Research studies show that online courses can bring high-quality education to more students while online courses are easily accessible to all students, no matter where they are geographically located [22]. Czerniewicz et al. [23] point out that there are studies investigating the provision of academic content through e-learning in general and mass open online

courses (MOOCs), their problems, and expected benefits. Mulder and Jansen [24] add that MOOCs can improve access to education but that questions related to Internet accessibility, digital literacy, and the medium of delivery need to be answered first.

Much effort in the e-learning environment relates to the assumption that when content is offered online, students can access it to meet the course requirements and achieve a certain level of knowledge of the topic. However, students participating in online courses also face several psychological and socio-cultural problems. These problems can lead to a high rate of non-completion of online courses. In the early 1990s, researchers pointed out that computer-mediated communication is impersonal and antisocial [25][26], which is still considered one of the main problems today. Wegerif [27] pointed out that the lack of social presence causes a low level of commitment. Moreover, it can also lead to withdrawal from the online environment. Penstein Rosé et al. [28] found that social factors make an important contribution to the use/non-use of online courses.

Numerous studies have shown that students acquire more knowledge and prefer to learn through direct communication (face-to-face), making it easier also for the teacher to gain a common understanding and conceptual knowledge. Therefore, there is a need to monitor and ensure the teacher's cognitive presence if students are educated online [29][30]. The teacher's cognitive and social presence is very important for more intensive student involvement in the online courses. This often leads to better meeting students' needs and increases their motivation for online course participation [31]. Barnett [32] added that teacher cooperation with students in online courses has a positive effect on the intention of students to attend the online course.

Blended learning is the teaching mode where online access to course content is integrated with personal (face-to-face) teaching and personal communication [33]. The blended teaching model seems to precede online and personal teaching [34]. Therefore, blended learning in higher education is recognised as one of the biggest trends in training and education [35]. Most blended learning studies have shown that this positively affects student achievement and satisfaction, as the inclusion of online learning resources and activities for students improves learning outcomes in higher education [36][37].

Some other researchers got up with similar learning outcomes through blended and personal (face-to-face) ways of learning [38][39]. In their study, Rossiou and Sifaleras [40] studied the factors influencing student participation in using e-tools and e-content. They pointed out that the main reasons for not involving students in online courses are lack of internet access, other technical issues, and lack of time, awareness, and engagement. Anderson et al. [41] pointed out in their research that social patterns of student involvement are important, as not all students enrolled in online courses participate in the same way and are not equally engaged. Five categories of students (observer, spectator, collector, versatile, and rescuer) were identified, differing in the style of collaboration and time of interaction.

Research collaboration between teacher and student is a central element of the academic relationship. It should be emphasised that students expect expertise, support, and a balance between creativity and criticism of the teacher [42]. Modern e-learning platforms, especially their collaborative work functionalities, enable new dimensions of blended learning. At the same time, personal communication in the classroom can be replaced by face-to-face distant communication via a collaborative platform providing videoconferencing, to use collaborative platforms at an advanced level and ensure more active remote face-to-face communication by participants accepting these platforms by users/students should be on an advanced level.

In recent years, the phrase "digital collaboration" has been frequently used also in education. The extent and different ways of collaboration are usually organisation-specific, influencing the portfolio of tools used to be efficient and successful [43]. Collaboration is inevitable in education, and if people simplify, collaboration occurs every time two or more persons cooperate towards a common goal—in the case of education, the goal is to achieve the expected learning output. Organisations must consider the reasons for digital collaboration to maximise the collaboration results of tools used [43]. Collaboration can be on different levels, depending on the learning process requirements. The challenge there is in knowing the learning process well enough to support it to the right extent with collaboration tools. Many advantages come with the digital collaboration, which impacts sustainability issues in learning, including the following:

- Saved time—Being able to finish a process or a task faster automatically means saving time and, as such, means fewer costs;
- Strengthened team relationships—One can see students enrolled in a course as closely connected groups. So, it comes to be very valuable to be capable of maintaining sound and effective relationships within groups of participants. With modern collaboration tools, this can be supported and elevated so that every student has a better understanding of teamwork and mutual goals, of course, he attends;
- Better organisation of teaching work—Collaboration tools are facilitators to improve teaching, especially active learning.

Digital collaboration within learning in higher education can be described as a combination of tools and processes that enable teachers, students, and other participants to communicate and interact on different levels. This is achieved using selected platforms and tools [44]. Digital collaboration tools for business are an effective way for organisations to be able to

support different types of employees (working on location, working from home, working from anywhere) and still maintain effective business process flow. Similar is in higher education, where participants can use collaboration platforms and face-to-face communication tools. Innovation can be seen lately in digital collaboration, which is driving efficiency and productivity with the combination of traditional tools, social media, and other modern tools that create unique, sustainable working environments [45]. In higher education, this is seen in the integration of collaboration platforms and tools with traditional e-learning platforms for access to digitalised content of courses.

Digital collaboration supports remote employees to connect to others seamlessly, completing their tasks and communicating. In higher education, digital collaboration enables students and teachers to be connected seamlessly. This positively impacts efficiency and enables better group dynamics and relationships within courses conducted in blended mode and using collaboration platforms and tools. Digital collaboration is in some way progressive but is getting increasingly common. For innovative organisations, the challenge is in developing even newer, more advanced platforms and tools to differentiate themselves and be leaders in their field.

For sustainable learning enabled by blended learning mode, e-learning platforms and collaboration platforms used to foster digitalised face-to-face collaboration must be accepted by students accordingly. Their user experience with e-learning and collaboration platforms must be as high as possible.

3. User Experience

Different aspects can be used to evaluate software applications from the user's viewpoint. Some are quantitative, but it often depends on the user's subjective opinion, whether he or she finds an application good or not. Recently for such evaluations concept of user experience (UX) has been used. User Experience (UX) is defined as the actual end-user experience with the application. The International Standards Organization (ISO) describes user experience as "a consequence of the presentation, system performance, functionality, interactive behaviour, and assistive competencies of an interactive system, both software, and hardware. It is also a consequence of the user's prior experiences, skills, attitudes, personality, and habits [46]". It is limited to software products, services, and systems with everything that suits the user's journey and creates a user experience before using the software product, service, or system [47].

Great user experience provides better work motivation and performance and can also impact the welfare of users [48][49]. Therefore, it can be assumed that a good user experience will lead to a higher level of satisfaction, which can ensure better use of the product, service, or system. User experience is most frequently connected with software products and applications, concentrating on ensuring end users have a clear and useful experience with the solution interface. The concept of user experience is more complex than the user interface (UI) concept. After all, software cannot be viewed in just one way, as users can gain experience not only while using this software. Users' perception is also influenced by the accompanying service and the entire system of a product [47]. Lallemand et al. [50] expose that usability is often seen as necessary for a good user experience. One of the widely used definitions of usability defined by the International Standards Organization (ISO; standard ISO/IEC 9241) is: "the degree to which particular users can use a system, service or product to achieve particular goals with efficiency, effectiveness, and satisfaction in a particular context of use [46]". There is some significant distinction between user experience and usability. Hassenzahl [48] revealed that the user experience has five unique features that distinguish it from usability. First, it is subjective, as it relies heavily on human perception. Second, it is holistic, including both hedonic and pragmatic use characteristics. Third, it is dynamic because it changes over the period. Fourth, it is context-sensitive, as it is always in some context, and fifth covers the positive and essential consequences of use. Therefore, user experience is involved with a user's complete experience while using a system that is more inclined to their emotional views. In contrast, usability is evaluating the excellence of their system use based on efficiency, effectiveness, and satisfaction measures. To sum up, user experience can be evaluated regarding reaching different hedonic aims, for example, emotion, and human behaviour, as well as response generated based on interactive experience. While usability is assessed concerning reaching some performance objectives such as accessibility, safety, learnability, and similar [51].

Designers' goal regarding positive user experience is to provide the intended software applications with interest, enjoyment, and gratification.

From a user point of view, abilities are apparent, estimated, and experienced in the perspective of use, preferably leading to interest, enjoyment, and gratification. Still, this can only be accomplished by a particular degree of hedonic and pragmatic qualities. A product's substance and usefulness should be sufficient and beneficial with interactions that are easy to understand and effortless. Thus, the presentation should be attractive, pleasant, and compatible with the character of the brand [47].

Kashfi et al. [52] expose that agreed-upon lists of principles and practices which will identify good user experience are still unavailable. Scattered examples of user experience principles and practices can be found in user experience studies. **Table 1** summarises user experience principles, practices, tools, and methods and also shows some examples [52].

Table 1. The definitions of user experience concepts.

Term	Description with Examples
UX principles	**Critical factors and basic concepts indicate the understanding of the user experience, which professionals must consider in their work. Example: The hedonic and pragmatic aspects of software application development play an essential role in user experience design as user experience is temporary.**
UX practices	**Includes actions that practitioners need to perform to comply with the user experience principles. Examples of practices are: recognizing users' personal goals and desires, preparing prototypes, including users in the design process, and assessing software from a hedonistic and pragmatic perspective.**
UX software	**Computer-aided software that developers or designers use to perform a variety of UX practices is usually designed to support specific methods to allow for more systematic software development. Examples: eye-tracking software, persona preparation, visual design, and prototyping software.**
UX techniques	**They allow practitioners to select and load a structure based on best practices, thus allowing them to be more systematic, and therefore, they are also more likely to succeed. Examples are questionnaires and surveys, mind plans, cognitive mapping, field research, and design studio.**

User experience evaluation is the research topic of many studies, and many assessment techniques have been created and used within these research studies. Researchers claim that it is difficult to assess and measure user experience. People who use a particular software product can have implicit experience with it through anticipations based on current understanding of associated technologies, brands, demonstrations, advertisements, presentations, etc. Roto et al. [53] argue that the implicit experience expands after usage, such as the image of the earlier use or changes in the assessment of people's use. Another important aspect to consider in user experience is also timeframe. It can be argued that user experience changes over time (prior to use, during use, after use, and past use); people can focus only on what someone experienced while using the software product in a short time. On the other hand, people can concentrate on the aggregated understanding developed across a string of use encounters and phases of non-use that might reach over extended periods. User experience can consequently indicate a specific impression during use (momentary user experience), a judgment of a particular episode of usage (episodic user experience), or opinions about a complete system after using it for a longer time (cumulative user experience). Anticipated user experience could correlate to the time prior to first use. A summary of different types of user experience is presented in **Table 2** [53].

Table 2. User experience dimensions.

When	What	How
Prior to use	**Anticipated user experience**	**Expectations about the experience.**
During use	**Momentary user experience**	**Facing with the experience.**
After usage	**Episodic user experience**	**Thinking about the experience.**
Past use	**Cumulative user experience**	**Call to mind several periods of use.**

Various methods are specifically created to assess and research UX-related concepts. For the research, the researchers used a standard freely available User Experience Questionnaire (UEQ) questionnaire [54][55] to measure interactive product and service UX.

4. Conclusion

Traditional classroom education is understood to be structured and well methodologically developed, with little opportunity for collaborative, spontaneous or experiential learning (see [56][57]). The rigidity of traditional education often differs from online learning, which involves digital media, such as device use (computer, tablet, or mobile phone) and video [58][59][60]. Technology has traditionally been used by teachers to support limited and in most cases one-way interaction with students without full integration in courses [61]. Abbas et al. [42] pointed out that the centre point of the educational innovation projects today are game-based curriculum developments, e-learning platforms, distance and hybrid learning. They added that online synchronised and asynchronous teaching practices had become a widespread alternative to courses, which has been achieved through the modernisation and redesign of education systems that incorporate emerging technologies. E-learning enhances spontaneity, interactivity, and experimental learning. E-learning usually mentions the following skills: problem-solving, teamwork, interdisciplinary thinking, and holistic thinking. These skills, encompassed by problem-based pedagogy, offer students chances to learn to think, especially question how to think instead of question what to think [62], can also be incorporated into its content sustainable pedagogy [63][64][65]. In detecting measures and characteristics for assessing e-learning platforms peculiarity of e-learning has to be considered. The primary goal of the e-learning platform is to enable students to understand didactic content so that as little effort as possible is required to interact with the platform. Interaction between teacher and student is important for better outcomes from teaching [42].

References

1. Remali, A.M.; Ghazali, M.A.; Kamaruddin, M.K.; Kee, T.Y. Understanding Academic Performance Based on Demographic Factors, Motivation Factors and Learning Styles. Int. J. Asian Soc. Sci. 2013, 3, 1938–1951.
2. Indreica, S.E. eLearning platform: Advantages and disadvantages on time management. In Proceedings of the 10th International Scientific Conference eLearning and Software for Education, Bucharest, Romania, 24–25 April 2014; pp. 236–243.
3. Virtič, M.P. The role of internet in education. In Proceedings of the DIVAI 2012, 9th International Scientific Conference on Distance Learning in Applied Informatics, Štúrovo, Slovakia, 2–4 May 2012; pp. 243–249.
4. Alexe, C.M.; Alexe, C.G.; Dumitriu, D.; Mustață, I.C. The Analysis of the Users' Perceptions Regarding the Learning Management Systems for Higher Education: Case Study Moodle. In Proceedings of the 17th International Scientific Conference on eLearning and Software for Education, eLSE 2021, Bucharest, Romania, 22–23 April 2021; pp. 284–293.
5. Abbas, A.; Hosseini, S.; Núñez, J.L.M.; Sastre-Merino, S. Emerging technologies in education for innovative pedagogies and competency development. Australas. J. Educ. Technol. 2021, 37, 1–5.
6. Alturki, U.; Aldraiweesh, A. Application of Learning Management System (LMS) during the COVID-19 Pandemic: A Sustainable Acceptance Model of the Expansion Technology Approach. Sustainability 2021, 13, 10991.
7. Sarnou, H.; Sarnou, D. Investigating the EFL Courses Shift into Moodle during the Pandemic of COVID-19: The Case of MA Language and Communication at Mostaganem University. Arab World Engl. J. 2021, 24, 354–363.
8. Bakhmat, L.; Babakina, O.; Belmaz, Y. Assessing online education during the COVID-19 pandemic: A survey of lecturers in Ukraine. J. Phys. Conf. Ser. 2021, 1840, 012050.
9. Polhun, K.; Kramarenko, T.; Maloivan, M.; Tomilina, A. Shift from blended learning to distance one during the lockdown period using Moodle: Test control of students' academic achievement and analysis of its results. J. Phys. Conf. Ser. 2021, 1840, 012053.
10. Hill, P. New Release of European LMS Market Report. eLiterate 2016. Available online: https://eliterate.us/new-release-european-lms-market-report/ (accessed on 7 June 2022).
11. Somova, E.; Gachkova, M. Strategy to Implement Gamification in LMS. In Next-Generation Applications and Implementations of Gamification Systems, 1st ed.; Portela, F., Queirós, R., Eds.; IGI Global: Hershey, PA, USA, 2022; pp. 51–72.
12. Al-Ajlan, A.; Zedan, H. Why Moodle. In Proceedings of the 12th IEEE International Workshop on Future Trends of Distributed Computing Systems, Kunming, China, 21–23 October 2008; pp. 58–64.
13. Kintu, M.J.; Zhu, C.; Kagambe, E. Blended learning effectiveness: The relationship between student characteristics, design features and outcomes. Int. J. Educ. Technol. High. Educ. 2017, 14, 7.
14. Evgenievich, E.; Petrovna, M.; Evgenievna, T.; Aleksandrovna, O.; Yevgenyevna, S. Moodle LMS: Positive and Negative Aspects of Using Distance Education in Higher Education Institutions. Propós. Represent. 2021, 9, e1104.
15. Oproiu, G.C. Study about Using E-learning Platform (Moodle) in University Teaching Process. Procedia Soc. Behav. Sci. 2015, 180, 426–432.
16. Parusheva, S.; Aleksandrova, Y.; Hadzhikolev, A. Use of Social Media in Higher Education Institutions—An Empirical Study Based on Bulgarian Learning Experience. TEM J. Technol. Educ. Manag. Inform. 2018, 7, 171–181.
17. Ironsi, C.S. Google Meet as a synchronous language learning tool for emergency online distant learning during the COVID-19 pandemic: Perceptions of language instructors and preservice teachers. J. Appl. Res. High. Educ. 2022, 14, 640–659.
18. Lewandowski, M. Creating virtual classrooms (using Google Hangouts) for improving language competency. Lang. Issues: ESOL J. 2015, 26, 37–42.
19. Herskowitz, N. Gartner Recognises Microsoft as Leader in Unified Communications as a Service and Meetings Solutions, Microsoft 365. 2021. Available online: https://www.microsoft.com/en-us/microsoft-365/blog/2021/10/25/gartner-recognizes-microsoft-as-leader-in-unified-communications-as-a-service-and-meetings-solutions/ (accessed on 7 June 2022).
20. Microsoft. Welcome to Microsoft Teams. 2021. Available online: https://docs.microsoft.com/en-us/microsoftteams/teams-overview (accessed on 30 April 2021).
21. Florjancic, V.; Wiechetek, L. Using Moodle and MS Teams in higher education—A comparative study. Int. J. Innov. Learn. 2022, 31, 264–286.
22. Friedman, T. Come the Revolution. New York Times. 15 May 2012. Available online: http://www.nytimes.com/2012/05/16/opinion/friedman-come-the-revolution.html/ (accessed on 7 May 2022).
23. Czerniewicz, L.; Deacon, A.; Small, J.; Walji, S. Developing world MOOCs: A curriculum view of the MOOC landscape. J. Glob. Lit. Technol. Emerg. Pedagog. 2014, 2, 122–139.
24. Mulder, F.; Jansen, D. MOOCs for opening up education and the openupEd initiative. In MOOCs and Open Education around the World; Bonk, C.J., Lee, M.M., Reeves, T.C., Reynolds, T.H., Eds.; Routledge: New York, NY, USA, 2015.

25. Walther, J.B. Computer-mediated communication. Commun. Res. 1996, 23, 3–43.
26. Walther, J.B.; Anderson, J.F.; Park, D.W. Interpersonal Effects in Computer-Mediated Interaction: A meta-analysis of social and antisocial communication. Commun. Res. 1994, 21, 460–487. Available online: www.matt-koehler.com/OtherPages/Courses/CEP_909_FA01/Readings/CmC/Walther_1994b.pdf (accessed on 7 June 2022).
27. Wegerif, R. The social dimension of asynchronous learning networks. J. Asynchronous Learn. Netw. 1998, 2, 34–49. Available online: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.103.7298&rep=rep1&type=pdf (accessed on 7 May 2021).
28. Penstein Rosé, C.; Carlson, R.; Yang, D.; Wen, M.; Resnick, L.; Goldman, P.; Sherer, J. Social factors that contribute to attrition in MOOCs. In Proceedings of the First ACM Conference on Learning @ Scale Conference (' 14), Atlanta, GA, USA, 4–5 March 2014; Association for Computing Machinery: New York, NY, USA, 2014; pp. 197–198.
29. Paechter, M.; Maier, B. Online or face-to-face? Students' experiences and preferences in e-learning. Internet High. Educ. 2010, 13, 292–297.
30. Garrison, D.R.; Anderson, T.; Archer, W. Critical thinking, cognitive presence, and computer conferencing in distance education. Am. J. Distance Educ. 2001, 15, 7–23.
31. Chen, K.C.; Jang, S.J. Motivation in online learning: Testing a model of self-determination theory. Comput. Hum. Behav. 2010, 26, 741–752.
32. Barnett, E.A. Validation experiences and persistence among community college students. Rev. High. Educ. 2011, 34, 193–230.
33. Graham, C.R. Emerging practice and research in blended learning. In Handbook of Distance Education, 3rd ed.; Moore, M.G., Ed.; Routledge: New York, NY, USA, 2013; pp. 333–350.
34. Ross, B.; Gage, K. Global perspectives on blending learning: Insight from WebCT and our customers in higher education. In Handbook of Blended Learning: Global Perspectives, Local Designs; Bonk, C.J., Graham, C.R., Eds.; Pfeiffer Publishing: San Francisco, CA, USA, 2006; pp. 155–168.
35. Drossos, L.; Vassiliadis, B.; Stefani, A.; Xenos, M.; Sakkopoulos, E.; Tsakalidis, A. Introducing ICT in traditional higher education environment: Background, design and evaluation of a blended approach. Int. J. Inf. Commun. Technol. Educ. 2006, 2, 65–78.
36. Dziuban, C.; Moskal, P. A course is a course is a course: Factor invariance in student evaluation of online, blended and face-to-face learning environments. Internet High. Educ. 2011, 14, 236–241.
37. Means, B.; Toyama, Y.; Murphy, R.; Baki, M. The effectiveness of online and blended learning: A meta-analysis of the empirical literature. Teach. Coll. Rec. 2013, 115, 1–47.
38. Griffiths, R.; Chingos, M.; Mulhern, C.; Spies, R. Interactive Online Learning on Campus: Testing MOOCs and Other Platforms in Hybrid Formats in the University System of Maryland; Ithaka S+R: New York, NY, USA, 2014; Volume 10, pp. 1–81.
39. Joseph, A.M.; Nath, B.A. Integration of Massive Open Online Education (MOOC) System with in-Classroom Interaction and Assessment and Accreditation: An Extensive Report from a Pilot Study. WORLDCOMP '13. Available online: http://worldcomp-proceedings.com/proc/p2013/EEE3547.pdf (accessed on 11 April 2022).
40. Rossiou, E.; Sifalaras, A. Blended Methods to Enhance Learning: An Empirical Study of Factors Affecting Student Participation in the Use of E-Tools to Complement F2F Teaching of Algorithms. In Proceedings of the 6th European Conference on e-Learning (ECEL 2007), Dublin, Ireland, 4–5 October 2007; pp. 519–528. Available online: https://www.researchgate.net/publication/248392307_Blended_Methods_to_Enhance_Learning_An_Empirical_Study_of_Factors_Affecting Tools_to_Complement_F2F_Teaching_of_Algorithms (accessed on 10 April 2022).
41. Anderson, A.; Huttenlocher, D.; Kleinberg, J.; Leskovec, J. Engaging with massive online courses. In Proceedings of the 23rd International Conference on World Wide Web, Seoul, Korea, 7–11 April 2014; pp. 687–698.
42. Abbas, A.; Arrona-Palacios, A.; Haruna, H.; Alvarez-Sosa, D. Elements of students' expectation towards teacher-student research collaboration in higher education. In Proceedings of the 2020 IEEE Frontiers in Education Conference (FIE), Uppsala, Sweden, 21–24 October 2020; pp. 1–5.
43. Eisenhauer, T. Grow Your Business with Collaboration Tools. Axero Solutions, 2021. Available online: https://info.axerosolutions.com/grow-your-business-with-collaboration-tools (accessed on 5 May 2021).
44. Deloitte. Remote Collaboration Facing the Challenges of COVID-19. 2021. Available online: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/human-capital/Remote-Collaboration-COVID-19.pdf (accessed on 30 April 2021).
45. Madlberger, M.; Raztocki, N. Digital Cross-Organizational Collaboration: Towards a Preliminary Framework. In Proceedings of the Fifteenth Americas Conference on Information Systems, San Francisco, CA, USA, 6–9 August 2009; Available online: https://ssrn.com/abstract=1477527 (accessed on 30 April 2021).
46. ISO 9241-210; Ergonomics of Human-System Interaction Part 210: Human-Centered Design For Interactive Systems. International Organization for Standardization (ISO): Geneva, Switzerland, 2010. Available online: https://www.iso.org/standard/52075.html (accessed on 7 May 2022).

47. Van de Sand, F.; Frison, A.K.; Zotz, P.; Riener, A.; Holl, K. The intersection of User Experience (UX), Customer Experience (CX), and Brand Experience (BX). In User Experience Is Brand Experience. Management for Professionals; Springer Nature: Cham, Switzerland, 2020.
48. Hassenzahl, M. Experience Design: Technology for All the Right Reasons. Synth. Lect. Hum.-Cent. Inform. 2010, 3, 1–95.
49. Nass, C.; Adam, S.; Doerr, J.; Trapp, M. Balancing user and business goals in software development to generate positive user experience. In Human-Computer Interaction: The Agency Perspective; Springer: Berlin/Heidelberg, Germany, 2012.
50. Lallemand, C.; Gronier, G.; Koenig, V. User experience: A concept without consensus? Exploring practitioners' perspectives through an international survey. Comput. Hum. Behav. 2015, 43, 35–48.
51. Zaki, T.; Nazrul Islam, M. Neurological and physiological measures to evaluate the usability and user-experience (UX) of information systems: A systematic literature review. Comput. Sci. Rev. 2021, 40, 375.
52. Kashfi, P.; Feldt, R.; Nilsson, A. Integrating UX principles and practices into software development organisations: A case study of influencing events. J. Syst. Softw. 2019, 154, 37–58.
53. Roto, V.; Law, E.; Vermeeren, A.; Hoonhout, J. (Eds.) User Experience White Paper. Outcome of the Dagstuhl Seminar on Demarcating User Experience, Germany, 2011. Available online: http://www.allaboutux.org/files/UX-WhitePaper.pdf (accessed on 1 June 2022).
54. Schrepp, M. User Experience Questionnaire Handbook. 2019. Available online: https://www.ueq-online.org/Material/Handbook.pdf (accessed on 10 March 2022).
55. Schrepp, M.; Hinderks, A.; Thomaschewski, J. Applying the User Experience Questionnaire (UEQ) in Different Evaluation Scenarios. In Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience; Marcus, A., Ed.; Springer International Publishing: Geneva, Switzerland, 2014; pp. 383–392.
56. Resolutions Adopted by the Conference . Report of the United Nations Conference on Environment and Development. Retrieved 2022-8-9
57. Robert B. Gibson; Sustainability assessment: basic components of a practical approach. *Impact Assessment and Project Appraisal* **2006**, *24*, 170-182, 10.3152/147154606781765147.
58. Hannay, M.; Newvine, T.; Perceptions of distance learning: A comparison of online and traditional learning. *Merlot J. Online Learn. Teach.* **2006**, *2*, 1-11, .
59. Alla L. Nazarenko; Blended Learning vs Traditional Learning: What Works? (A Case Study Research). *Procedia - Social and Behavioral Sciences* **2015**, *200*, 77-82, 10.1016/j.sbspro.2015.08.018.
60. Scott A Engum; Pamela Jeffries; Lisa Fisher; Intravenous catheter training system: Computer-based education versus traditional learning methods. *The American Journal of Surgery* **2003**, *186*, 67-74, 10.1016/s0002-9610(03)00109-0.
61. Ar, A.Y.; Abbas, A. Role of gamification in Engineering Education: A systematic literature review. In Proceedings of the 2021 IEEE Global Engineering Education Conference (EDUCON), Vienna, Austria, 21–23 April 2021; pp. 210–213. https://doi.org/10.1109/EDUCON46332.2021.9454038.
62. Ian Thomas; Critical Thinking, Transformative Learning, Sustainable Education, and Problem-Based Learning in Universities. *Journal of Transformative Education* **2009**, *7*, 245-264, 10.1177/1541344610385753.
63. Gerry Geitz; Jan de Geus; Design-based education, sustainable teaching, and learning. *Cogent Education* **2019**, *6*, 7919, 10.1080/2331186x.2019.1647919.
64. Eleni Sinakou; Vincent Donche; Jelle Boeve-De Pauw; Peter Van Petegem; Designing Powerful Learning Environments in Education for Sustainable Development: A Conceptual Framework. *Sustainability* **2019**, *11*, 5994, 10.3390/su11215994.
65. Adar Ben-Eliyahu; Sustainable Learning in Education. *Sustainability* **2021**, *13*, 4250, 10.3390/su13084250.